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Proposed research topic : **"STUDIES ON FUNGAL DIVERSITY ASSOCIATED WITH GRAPE FIELDS IN THE MARATHWADA REGION"**

SHORT RESUME

INTRODUCTION

The earth's biological diversity is disappearing at an ever increasing rate (Wilson, 1988). To become aware of this fact one need only observe the conversion of natural areas to agricultural fields or the disappearance of old growth forests due to logging. The documentation of this loss has been based primarily on large organisms, such as mammals and vascular plants, however, evidence exists of an increasing decline in the diversity of the less conspicuous organisms such as the fungi including lichenized fungi, and bryophytes (Arnolds, 1988, 1989; Lizon, 1993; Pittam, 1991; Richardson, 1990). These poorly known but specious groups of organisms may actually be more vital to long term ecosystem survival than the well-known macrofauna and flora.

One potentially optimistic approach to slowing this loss of biological resources is to explore and characterize these resources in order to sustainably use them. Producing immediate revenue and recognizing their value as long term biological resources might protect them from destruction (Reid, et al. 1993). Some studies have made a moderate attempt to demonstrate that biological diversity is more economically valuable as a sustainable, long term resource than as a short term resource that ceases to exist after the quick payoff (Carr, et al. 1993). However, for those areas of the world that lack even the most basic economic resources, the consumptive use and immediate economic return on existing biological resources may appear to be the only option.

The fungi are a group of organisms that lend themselves to sustainable use. Many fungal species can be isolated non-destructively from their native habitats and can be grow in culture to be perpetuated and used indefinitely. Other groups of fungi such as the obligate

plant parasites and mycorrhizal species are difficult to obtain and propagate in pure culture but with care can be harvested from the wild in a manner that does not destroy the parent germplasm. Thus, just as fungi are vital components of ecosystems, knowledge of the fungi would add significantly to the goal of demonstrating the economic value of biological resources.

Most people encounter fungi as edible mushrooms produced under cultivation or gathered from the wild. In 1992 the value of this crop was about $700 million, just in the United States (Anon., 1992). There is increasing interest in expanding the range of species produced as edible fungi (Leonard & Volk, 1992) and in growing edible fungi on composted plant biomass as a means of converting waste material into a cash commodity (Chang & Miles 1989). In addition to a gourmet food item, fungi serve as a low-cost protein source made from *Fusarium graminearum* Schwäbe sold as Quorn with a market value of 25 million British pounds (Trinci, 1991).

Fungi, particularly as the asexual states of Ascomycetes, are important producers of biologically active molecules such as penicillin produced by *Penicillium chrysogenum* Thom. Cyclosporin A, the immune-suppressant drug used in organ transplant operations is produced by *Beauveria nivea* (Rostrup) Arx and the cholesterol-reducing lovastatin derives from *Aspergillus terreus* Thom. Stierle, et al. (1993) have shown that a previously undescribed fungus isolated from Pacific yew tree, *Taxus brevifolia* Nutt., produces the drug taxol effective in suppressing breast cancer. Such endophytic fungi that occur inside living plants represents a universe of microorganisms that have not been screened for products useful to humanity.

Fungi serve as the source of commercially important enzymes and natural products ranging from abscisic acid to zymosterol that result in a billion dollar industry (Edwards, et al., 1988; Lambert, 1983). They are increasingly used to ferment solid organic waste substrates into useable products such a methane and fertilizers (Fox, 1993) and are invaluable as substitutes for chemicals in the pulp and paper industry (Kirk, et al., 1993). Although new classes and sources of natural products are being discovered from fungi (Bills, et al., 1992, Bills, et al., 1994, Dreyfuss & Chapela, 1994), the search for organisms that produce useful secondary metabolites has been limited in scope. Samuels et al. (1994;

Kubicek pers. comm.) studying the genus *Trichoderma* have found at least two strains of *T. reesei* Simmons from tropical countries that produce the industrially important enzyme cellulase in much greater quantity than the strain currently used in commercial production. These strains were isolated from the *Hypocrea* ascospores that produce the asexual *Trichoderma* state, thus allowing the possibility of conventional genetic manipulation. The fungi as a biological resource of commercially important products are virtually untapped. Fungal species screened for secondary metabolites using modern techniques are less than 1% of those that may exist (Nisbet & Fox, 1991). Thus, the potential is enormous for the discovery of valuable natural products resulting from a directed search and screening of fungi from unexplored habitats.

In the production of food both in agriculture and in the food-processing industry fungi play influential roles. The filamentous fungi cause billions of dollars damage to agricultural crops, yet they hold the potential to serve as beneficial organisms in the biological control of insects, pathogenic fungi, and weeds (Miller & Rossman, 1994; Roberts & Hajek, 1993; Trujillo, 1993) and reduce the use of chemical fertilizers through enhanced formation of endomycorrhizae in crop plants (Jong & Birmingham 1993; Wood 1992). The fungi associated with roots are essential for the growth of over 90% of all vascular plants as both endomycorrhizae in crops and ectomycorrhizae developing in most woody plants (Allen, 1993). Marx et al. (1993) described the remarkable beneficial effect of inoculating tree seedlings with selected ectomycorrhizal fungi. The fungus-root association can be enhanced through the effective use of both ecto- and endomycorrhizae to reduce the need for fertilizer in working toward sustainable agricultural and forest systems.

Fungi have caused extensive damage when accidentally introduced into non-native habitats, as in, for example, chestnut blight caused by *Cryphonectria parasitica* (Murrill) Barr that destroyed the enormous chestnut trees of the eastern United States (Anagnostakis, 1987). With increased pressure to reduce trade barriers, knowledge is required about the fungi that could drastically influence agriculture and forest habitats. This information includes host range and geographic distribution in order to develop and enforce meaningful plant quarantine regulations. Such useful data would result from biodiversity inventory that includes fungi.

Increased knowledge of the diversity and characteristics of the fungi would contribute directly and indirectly to realizing the economic value of the earth's biological diversity and would strengthen the initiative to preserve our remaining biological resources.

Grape is one of the most commercially important fruit crops of the world. Among all of the fruits, grapes occupy first position in terms of area and production in the world. Grape is one of the first fruits to be cultivated by man (Mcgovern et al. 1995). It is a tropical and sub-tropical fruit and can be grown in a wide range of climatic condition. There are more than 1000 different varieties of grapes found all over the world. Grapes belong to the Vitaceae family. Grape is called queen of fruits'. Grapes are small round or oval berries that feature semi-translucent flesh encased by a smooth skin. Some contain edible seeds while others are seedless. Like blueberries, grapes are often covered by a protective, whitish bloom. It is one of the most delicious, refreshing and nourishing fruits of the world. It is fairly good source of minerals like calcium, phosphorus and iron and vitamins like B1 and B2. Grape is produced in over 91 Countries worldwide (APEDA). China and Italy stood at first and second position among grape producing countries in the world. At present India is 9th position among grapes growing countries of the world (Shikamany, 2001; Ramanan, 2012; Gade et.al, 2014)). In India, remarkable success has been achieved in table grape production and yield levels of fresh grapes are among the highest in the world. The country has the distinction of achieving the highest productivity of grape in the world, with an average yield of 25 to 30 tonnes per hectare (APEDA). The present paper attempts to study the prospect of grapevine cultivation in India.

Grape Cultivation Region in Maharashtra

This region covers Nashik, Sangli, Solapur, Pune, Satara, Latur and Osmanabad districts of Maharashtra; Hyderabad, Ranga Reddy, Mahbubnagar, Anantapur and Medak districts of Andhra Pradesh; and Bijapur, Bagalkot, Belgaum, Gulberga districts of northern Karnataka lying between 15° and 20° North latitude. This is the major grape growing region accounting for 80 per cent of the area under grapes in the country. Vines do not undergo dormancy and double pruning and a single harvest is the general practice in this region. Maximum temperature goes beyond 42° C during summer and minimum temperature is around 8° C in some locations during winter. The major problems in this region are soil and

water salinity and drought. Berry growth is impaired and in certain locations pink blush sometimes develops on green berries due to temperatures that drop to a low of 8° C. Thompson Seedless and its clones (Tas-A-Ganesh, Sonaka), Anab-e-Shahi, Sharad Seedless and Flame Seedless are the varieties grown in this region. Red Globe and Crimson Seedless are the commercial cultivars grown in this region with more than 90 per cent of area under Thompson Seedless and its clones. Due to the increasing demand of wine industry, wine varieties like Cabernet sauvignon, Chardonnay, Merlot, Shiraz and Sauvignon Blanc are being grafted in larger areas. Thompson Seedless grown in this region is highly susceptible to downy and powdery mildews.

Harvesting Season of Grape in India:

The harvesting season of major grapes producing areas in India is differs considerably. Different harvesting seasons of grapes in India, details is given below. Overall harvesting start from mid December and last up to June. Grapes are coming in to the market middle of January and peak time of availability is during February-March. However, harvesting of grapes can be advanced or postponed for about 10 to 15 days depending on the market situation. Availability season is extended further to April -May by keeping the produced grapes in cold stores.

Considering these facts the research topic entitled "Studies on Fungal Diversity Associated with Grape Fields in the Marathwada Region" is selected for the proposed research work.

REVIEW OF LITERATURE

Michal Pancher et al. (2012) studied the distribution of fungal endophytes of grapevine (*Vitis vinifera* L.) plants in a subalpine area of northern Italy, where viticulture is of high economic relevance. They adopted both cultivation-based and cultivation-independent approaches to address how various anthropic and nonanthropic factors shape microbial communities. Grapevine stems were harvested from several locations considering organic and integrated pest management (IPM) and from the cultivars Merlot and Chardonnay. Cultivable fungi were isolated and identified by internal-transcribed-spacer sequence analysis, using a novel colony-PCR method, to amplify DNA from fungal

specimens. The composition of fungal communities was assessed using a cultivation-independent approach, automated ribosomal intergenic spacer analysis (ARISA). Multivariate statistical analysis of both culture-dependent and culture-independent data sets was convergent and indicated that fungal endophytic communities in grapevines from organically managed farms were different from those from farms utilizing IPM. Fungal communities in plants of cv. Merlot and cv. Chardonnay overlapped when analyzed using culture-dependent approaches but could be partially resolved using ARISA fingerprinting.

Ficke et al., (2002) reported that that diffuse powdery mildew colonies that were not visible in the field predisposed berries to bunch rot by Botrytis cinerea, increased the levels of infestation by spoilage microorganisms, and substantially degraded wine quality. Our improved understanding of the nature, causes, and stability of ontogenic resistance in the grapevine/ powdery mildew system has supported substantial changes in how fungicides are used to control the disease. Present applications are more focused on the period of maximum fruit susceptibility instead of following a calendar-based schedule. This has improved control, reduced losses, and in many cases reduced the number of fungicide applications required to suppress the disease. Particularly where fungicides are deployed in a programmatic fashion and ontogenic resistance is dynamic, there may be equivalent improvements to be made in other host– pathogen systems through studies of how host susceptibility changes through time.

Castoria et al., (2001) reported that *Aureobasidiumpullulans* (isolate LS-30) displayed significant antagonistic activity against *Botrytis cinerea*, *Penicillium expansum*, *Rhizopus stolonifer*and *Aspergillus niger* on table grapes, and *B. cinerea* and *P. expansum* on apple fruit. To improve the performance of this yeast-like fungus, possible modes of action were investigated. Competition for nutrients appeared to play a role in the activity of this antagonist. Extracellular exochitinase [*N*-acetyl-β-D-glucosaminidase (Nagase)] and β-1-3-glucanase activities were also detected both in vitro and in apple wounds, which are the main sites of penetration of postharvest fungal pathogens, suggesting that these enzymes may actually be involved in the antagonistic activity of this microorganism. Neither antibiosis nor direct physical interaction of LS-30 cells with the hyphae of *B. cinerea* appeared to be involved in the activity of this antagonist.

Omer et al. (1995) reported that seven different genera of secondary fungi were isolated from surface disinfected feeding sites of phylloxera but none from surface-disinfected root tissues undamaged by phylloxera. Damage in vines infested with phylloxera and infected with Fusarium solani (MnxT.) or with F. solani and Pythium ultimum Teow. was significantly greater than damage in vines infested with phylloxera only. In a greenhouse experiment, total biomass was reduced by 16 % in vines infested with phylloxera and 24 to 29 % in vines infested with phylloxera and infected with fungus in comparison with control vines. Chlorophyll content, average internode length, shoot biomass, and root biomass in the uninfected, uninfected vines were significantly greater than vines infested with phylloxera or vines infested with phylloxera and infected with F. solani or P, ultimum, or both. Preventative treatment with metalaxyl, benomyl or copper quinolinolate fungicides significantly decreased damage in phylloxera infested vines in comparison with untreated vines.

Lone, *et. al.* (2011) isolated and characterized fungal species from the rhizosphere *Juglans regia* L. of Kashmir Valley. They isolated 26 isolates of fungi from different sites.

Shivann and Vasanthakumari (2011) studied the rhizosphere fungal species in the rhizosphere and rhizoplane of perennial grasses the family Chloridoideae in Lakkavalli region of the Western Ghats in India. Were characterized by culturing on PDA medium.

El-Amin and Saadabi (2007) isolated the soil fungi in rhizosphere of Sugarcane from Sudan and found that Thirteen species were new to Sudan. The number of Colonies declined at the maturity of crop and even the rhizosphere fungal microflora in different sites were slightly varying

Rekha, *et. al.* (2010) studied the antibacterial activity of *Pseudomonas fluorescens* isolated from Rhizosphere soil. A proteobacterium was isolated from rhizosphere soil and it was identified using morphological, cultural and biochemical characteristics as *Pseudomonas fluoresecens*.

Abdel-Hafez, *et. al.* (2012) studied the diversity of *Fusarium* species and other fungi associated with rhizosphere and rhizoplane of lentil and seasame plants at different stages from Egypt. They isolated sixteen species of *Fusarium* from rhizosphere (13 species) and rhizoplane (11 species). The species of *Fusarium were F. chlamydosporum, F. culmorum, F.*

nygamai, F. oxysporum, F. poae, F. iporotrichioides, F. subglutinans, F. tricinctum, F. verticillioides, and Fusarium spp. They observed *F. oxysporum, F. solani, F. verticillioides* from the rhizosphere and rhizoplane of both plants. The only *F. solani* was recorded at the three stages of both plants. The *Aspergillus* and *Penicillium* species also were recorded from both rhizosphere and rhizoplane of both the plants.

Afzal, *et. al*. (2013) isolated eight species by using two different media such as Czapak's Dox Agar solution and Malt Extract agar studied the species of *Aspergillus* from soil of Larkan district of Pakistan. Using microscopic characteristics including conidiophores, vesicle, matulae, phialides and conidia. They reported 8 species of Aspergillus mainly *A. ficcum, A. flavus, A. flavus var. columnariris, A. terreus var. aureus, A. fumigatus, Emericella nidulans, E. rugulosa* and *A. terricola var. ameicana.* This species was reported in new record from Pakistan.

Khattak, *et. al* (2014) Two fungi, one isolated from the rhizosphere of *Mentha piperita* and the other isolated from the top soil (20 cm) of the agricultural farm of the University of Agriculture Peshawar, Pakistan. The rhizospheric fungus was identified as *Aspergillus* and *Penicillium* as soil born. The dried crude extracts of *Aspergillus* and *Penicillium* species were screened for phytotoxic bioassay and herbicidal activities (against *Lemna minor* and the weed *Silybum marianum* L., respectively) in order to evaluate the agrochemical importance of the extracts. Different dose concentrations (10, 100 and 1000 µg mL-1) of the ethyl acetate and n-Hexane fraction of both the species were tested against *Lemna minor* and seeds of *Silybum marianum* L. A dose concentration of 1000 µgmL-1of ethyl acetate extract and n-Hexane fraction of *Aspergillus* species inhibited the growth of *Lemna minor* by 65 and 85%, respectively; while the same dose concentration of ethyl acetate extract and n Hexane fraction of *Penicillium* species inhibited the growth of Lemna minor by 56.66 and 30%, respectively. In addition, the same dose concentrations of the crude extract from both the species completely inhibited the germination of the seeds of *Silybum marianum* L. The results showed that extract of both fungi has potential agrochemical constituents which might inhibit the growth of *Silybum marianum* L. and *Lemna minor*.

Saler, *et. al.* (2012) studied the rhizosphere microfungi of Groundnut (*Arachis hypogeal* L.) C. V. SB-11 from Nashik of Maharastra. All together 21 and 18 fungal species were recorded by several dilution plate count technique. Out of 21 fungal species of which 14 were from the rhizosphere whereas 17 from soil. A total of species of fungi were recorded from Difolatan. Only *Aspergillus carbonarius* showed tolerance up to 80 ug /ml.10 ug /ml tolerance shown by *Mucor circinelloides, Rhizopus stolanifer*, *Aspergillus niger, Trichoderma viride* while 30, ug /ml tolerance was shown by *Aspergillus fumigatus, Fusarium oxysporum.*

Chutia and Ahmed (2012) studied the diversity of *Penicillium* spp. and associate mycobiota from different virgin forest floor in the Brahmaputra Valley, Assam, India was analyzed. Soil samples were collected from six different undisturbed forest floors together with seasonally flooded forest and also from agricultural field. The isolated fungal species were identified based on morphological and reproductive characteristics. About 18 common fungal species from different soil samples were isolated dominated by *penicillium* sp. and *Aspergillu*s sp. Among the 30 isolates of *penicillium,* few species have shown antimicrobial activity against the tested bacterial pathogens. The cultural of four different isolates showed antimicrobial activity against *streptococcus bombycis*, *Aeromonas salmonicida staphylococcus aureus* and *E. coli.*

Yadav and Bhagat (2014) Studied *Ocimum sanctum* L, *Adhatoda vasica* Nees) and *Aloe vera* L. were selected for rhizosphere study. *Ocimum sanctum* L, *Adhatoda vasica* Nees and *Aloe vera* L. showed antifungal activity. Indian soil contain *Aspergillus* spp., *Rhizopus* spp., *Fusarium* spp., *Cephalosporium* spp., *Alternaria* spp., *Penicillium* spp.,*Trichoderma* spp., *Curvularia* spp., *Cladosporium* spp., *Phoma* spp., *Botrytis* spp., *Rhizoctonia* spp., *Colletotrichum* spp, *Absidia corymbifera*, *Verticillium* spp*., Phytophthora* spp., *Chaetomium* spp., *Nigrospora saccha*, *Helminthosporium* spp.

Suryanarayanan and Vijaykrishna (2001) studied fungal endophytes of aerial roots of *Ficus benghalensis*. Mitosporic fungi and several sterile forms were isolated as endophytes from the leaf tissues and aerial roots of *Ficus benghalensis (Moraceae*). Although similar number of endophyte species was present in lamina and petiole, the endophytic fungi more densely colonized the petiole. The species composition and the colonization frequency of the

endophytes were more for the aerial roots entering the soil when compared with those growing in the air since the roots recruited some endophytes from the soil. The endophyte assemblages of the leaf and aerial root and of the aerial root growing in the air and soil showed little overlap suggesting that the nature of the host tissue as well as the environment determine the endophyte composition of a host.

Romero *et.al* (2001) isolated endophytic fungi from leaves of the weed *Parthenium hysterophorus* in order to establish whether the endophytes were the same fungi as had previously been recorded on scenescent or diseased leaf tissues. Seven surface sterilization methods were used. They isolated *Alternaria zinniae,* A.*helianthi, Cylindrocarpon sp., Curvularia brachyspora, Fusarium sp., Nigrospora oryzae, Penicillium funiculosum* and *Periconia sp*.

Khan *et al* (2007) studied the diversity of endophytic fungi from stem and leaves of *Calotropis procera* (Ait.) R. Br., a widely used medicinal plant in Indian sub-continent,at Karachi University campus Pakistan. A total of 8 fungal species viz., *A. flavus, A. niger, Aspergillus* sp*., Penicillium sublateritium, Phoma chrysanthemicola, P. hedericola, Phoma* sp., and *Candidaalbicans* were isolated. Among the endophytic flora, *Phoma* was the most prominent genus.Interestingly, no endophyte was isolated from 118 leaves samples and overall colonization frequency'

Gangadevi and Muthurrary (2008) isolated *Colletotrichum ziropori* a novel taxol producimg fungus from leaves of *Justicia gendarussa* from Chennai . The fungus was identified on the basis of morphological characters, spores characters; the taxol produced was quantified by using HPLC

Tran *et al.* (2010) isolated endophytic fungi from phyllodes of *Acacia* species from Australia. They isolated and identified bioactive properties like antibacterial and antifungal, even amylase activity have been studied by them.

Goveas *et al*. (2011) studied the endophytic fungi from the critically endangered medicinal plant, *Coscinium fenestratum* and it was investigated for the first time. The ubiquitous presence of fourty one endophytic fungi belonging to sixteen different taxa was identified from 195 samples of healthy leaves and stem, using traditional morphological

methods. The overall colonization rate of endophytes in both the leaf and the stem was found to be 21.02%.The stem showed low percentage frequency of colonization of the endophytic fungi when compared to leaf segments. Among the endophytic flora, *Phomopsis jacquiniana* was found to be the core-group fungus with a colonization frequency of 4.6%.

1. OBJECTIVES OF RESEARCH

1. To determine diversity of fungi associated with grape fields and explore their rule in protection and promoting plant growth.
2. To identify the diseases and preventing serious outbreaks and losses in yield of grape filled.
3. To study the effect of different environmental conditions on growth and development of fungi.
4. To analyze the Morphological and Biochemical Characterization of isolated fungi.
5. To study the biological activity of isolated fungi.
6. To investigate the beneficial and harmful fungi from soil, root zone, plant surfaces and air of grape field.

METHODOLOGY TO BE ADOPTED

Selection of plants species, Collection of plants samples, Isolation of fungi from grape fields, Calculation of Colonizing Frequency, Preservation of Culture, Morphological identification, Morphological and biochemical characterization by standard microbiological and biochemical methods (Smibert RM, Krieg 1995; Sneath, 2001).

2. IMPORTANCE OF STUDY

National and International status

In India, Nashik, Sangli, Solapur, Pune, Satara, Latur and Osmanabad districts of Maharashtra; Hyderabad, Ranga Reddy, Mahbubnagar, Anantapur and Medak districts of Andhra Pradesh; and Bijapur, Bagalkot, Belgaum, Gulberga districts of northern Karnataka

lying between 15° and 20° North latitude. This is the major grape growing region accounting for 80 per cent of the area under grapes in the country. Vines do not undergo dormancy and double pruning and a single harvest is the general practice in this region. Maximum temperature goes beyond 42° C during summer and minimum temperature is around 8° C in some locations during winter. The major problems in this region are soil and water salinity and drought. Grape is one of the most commercially important fruit crops of the world. Among all of the fruits, grapes occupy first position in terms of area and production in the world. Grape is one of the first fruits to be cultivated by man (Mcgovern et al. 1995). It is a tropical and sub-tropical fruit and can be grown in a wide range of climatic condition. There are more than 1000 different varieties of grapes found all over the world. Grapes belong to the Vitaceae family.

There are good reasons for isolating plant associated microorganisms, e.g. for their characterisation, for studying population dynamics and diversity, use of microbial inoculants to improve plant growth and plant health, and as sources of novel biologically active secondary metabolites. There is much work on epiphytes and endophytes especially on biological activity and diversity analysis; the data on microbes associated with grape plant is scarce. Such work is mainly concentrated in countries like China, Indonessia, Thailand and India where the use of medicinal plants is much higher.

Dattu Singh et al (2013) from Gulbargra University, Gulberga, isolated a fungus *Pencillium sp*. from healthy leaves of *C. longa* (turmeric) and found that it is a good producer of silver nanoparticle with promising antibacterial activity against *Ps. aeruginosa, K. pneumonia.* Agnes et al (2013) from Kerala identified two species of endophytic *Paenibacillus* from the rhizome as indole 3 acetic acid producers. Anisha et al (2013) from Kottayam, Kerala isolated endophytic *Klebsiella sp.* from *Curcuma longa* with potential plant growth promoting activities.

Significance of the study:

Rapid, accurate identification of diseases in the vineyard is key to preventing serious outbreaks and losses in yield and quality. However, the presence of a pathogen or disease does not necessarily mean that a treatment is required. The severity of diseases varies from

year to year, depending primarily on weather conditions, the presence of inoculum (history of the disease) and the susceptibility of the vines. This means that a disease can be devastating one year and insignificant the next. The measures to be taken to prevent losses may therefore vary from season to season. Accurate identification of pests is critical to an effective management program that provides optimal control while minimizing pesticide use. The plant associated microbes lives in varying relation with the host, the host provide nutrients to the microbes and in turn the plant get benefited from the associates by promoting plant growth, increase yield, vigour tolerance to a list of biotic and abiotic stress such as increased resistance against plant pathogens and parasites, tolerance against pH, temperature, drought, salinity etc. Production of active metabolites by the associates contributes much to the host plant. Exploitation of their beneficial properties is of great relevance at an applied level, either to increase production yields of agricultural crops, control of plants diseases or pests, adapt plant to suitable growth conditions.

The aim of this study is to identify the fungal community associated with grape plant and explore their possible role in plant protection and plant growth promoting activities

PROPOSED WORK PLAN/ FORMULATION AND STRUCTURE OF STUDY:

1st year:-

1. Reference work
2. Collection of samples
3. Isolation and identification of fungi
4. Study of fungal characterization
5. Biochemical studies

2nd year:-

1. Collection of samples
2. Isolation and identification of fungi
3. Fungal characterization
4. Biochemical studies

3rd year:-

1. Collection of samples
2. Isolation and identification of fungi
3. Fungal characterization
4. Biochemical studies
5. Data compilation

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